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Abstract

RECENT DEVELOPMENTS CONCERNING FRENCH FUEL ELEMENTS USED IN NATURAL URANIUM - GRAPHITE - CO_2 REACTOR SYSTEMS

by MM. M. SALESSE
J. A. STOHR
G. JEANPIERRE

(Commissariat à l'Energie Atomique, France)

The policy followed in France for the development of fuel elements for reactors belonging to the Electricité de France has been to benefit as much as possible, for each new pile from the most recent technical progress by developing in each case a fuel element allowing the maximum power per channel.

The two latest fuel elements thus studied by the French Atomic Energy Commission are of two different types :

- a tubular uranium element closed at both ends and cooled externally.

This type of element, chosen for the reactors EDF 2, EDF 3 and EDF 4 makes it possible to attain maximum specific powers of the order of 6 MW/metric ton.

An open tubular uranium element cooled both internally and externally, called an "annular element" which in being studied as a possibility for EDF 5. Such an element makes it possible to attain specific powers of over 12 MW/metric ton.

The two types of element have the following common characteristics
- the can, for external cooling, has herning-bone type fins.

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This type of profile which has been vastly improved recently thereby increasing its thermal efficiency, has the important advantage of avoiding vibration of the element, but has posed problems of resistance to thermal cycling necessitating much research.

- the fuel rods are placed inside graphite jackets, this limiting the vertical forces to which they are subjected and protecting them during charging and discharging.

On the other hand, these elements present very different problems as for as the following points are concerned :

- the characteristics required of the uranium tubes apart of course from a good dimensional stability during irradiation in the two cases are in the case of the closed tubes a very high resistance to external pressure, and in the case of the annular elements a low neutron absorption. Thus for each of these two cases it has been necessary to develop a suitable type of alloy.

- a possible loosening of the can during thermal cycling, which is peculiar to the internal can of the annular element, has necessitated very much research work.

- the exact temperature drop at the contact between the uranium and the can, and the strength of the lower end of the cartridge are points which are increasingly crucial in the case of the annular element.

All in all the annular element thus calls for a great research effort. This effort is justified by the big step forward in which it will result in the case of the EDF reactors thanks to its high specific power and to the high weight of uranium in each cartridge.